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THE
BOTANICAL COLLECTOR'S
GUIDE:

A MANUAL
FOR STUDENTS AND COLLECTORS;
CONTAINING
DIRECTIONS FOR THE COLLECTION AND PRESERVATION
OF PLANTS AND THE FORMATION OF
A HERBARIUM.

BY
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PREFACE.

The following pages have been written in response to an evident want respecting the methods of collecting plants and forming a herbarium according to a uniform standard as based upon the best practice. The object in view has been to meet the requirements of pupils in the public schools and students in college, and, for this reason, certain subjects are touched upon which otherwise might seem somewhat out of place here. While in no sense directed to the needs of the professional collector or of botanists who have already gained considerable experience in the field, it is hoped that the suggestions offered may not be wholly without value for them.

Attention has been given only to those methods, forms of utensils and kinds of material which, in our experience and judgment, have the best claims to consideration. There is, therefore, in some cases, opportunity for the exercise of individual taste and judgment, based upon the general principles laid down, and guided by experience already gained.

D. P. P.

Montreal, August, 1891.

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CHAPTER I.
INTRODUCTORY.

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I.

INTRODUCTORY.

For several years it has been customary, in connection with the regular course of Botany in McGill University, to give at its conclusion, one or two lectures on the methods of collecting plants and forming a herbarium. This material is now embodied in the present volume, which, it is hoped, may prove of service in securing a much desired uniformity of method among teachers and collectors.

For professional collectors, those who have already had large experience in the field, and are, therefore, independent of special directions, the suggestions given can be considered

of value only so far as they insure uniform practice.

The rules here laid down are to be regarded as having special application to teachers of schools who, for various reasons, may not have had opportunities for gaining a knowledge of the proper requirements of making a collection, and to amateurs and students who feel that some special guidance will be of service:

Upon the character of the training given, and the methods employed by teachers in the various preparatory schools, must largely depend the ultimate success of the university course which the pupil eventually takes in a given subject. If the methods of the school are not in harmony with the best recognized practice, the work there accomplished must be undone at the university before its methods can take full effect. But the impressions received at school are always the more lasting, because gained at a more receptive age: hence the difficulty of undoing what has been

improperly done is very great, and the labor of the higher teaching is very appreciably augmented.

It is therefore of the first importance, in order that all the various stages of a study may be prosecuted by a pupil, each in harmony with the others, that some recognized standard be adopted at the outset. It is hoped that, so far as the study of plants is concerned, this object may be secured by what is contained in the following pages.

The study of botany, as of other natural sciences, properly begins in the school, where it should be made, first of all, a study of natural objects, and secondarily, of a text-book. Because botany takes the pupil to Nature, teaches him to see and reflect upon what he observes, it has always been held as, and still enjoys the reputation of being, one of those sciences which, pre-eminently, is adapted to cultivating the powers of observation in the young.

The faculty of observation is an inherent

one; it is that which gives to the infant its first knowledge of the things about it, and under normal conditions of environment it continues to acquire strength, but under the unnatural conditions of education in which a child is too often placed, this faculty is dulled, and, in far too many cases, wholly destroyed.

Therefore, unless the power of observation has been destroyed by previous bad training or neglect, it is the duty of the teacher to take cognizance of that which Nature herself has provided, and, by judicious encouragement, foster a healthy development until the habit of close observation becomes well established.

But before the teacher, the parent is responsible, and it would be well were such natural guardians to realize that the undue repression of natural curiosity in a child is likely to stunt and ultimately destroy one of the most valuable gifts of Nature.

In teaching botany, then, no restriction

should be placed upon the study of actual specimens, but these should be supplied as freely as possible. When going into the field, acquire the habit of inspecting everything by the way, a by no means difficult task. Little by little the habit grows until all effort disappears, and unconsciously the mind absorbs whatever comes within the range of vision. Objects which escape the eye of the untrained observer are recognized with ease. From the outset, adopt the principle of making your observations close and accurate. For such data as are to be used in the future, and upon which accuracy of statement depends, a note-book should be carried in the pocket and made free use of, and this can safely be done without its implying any reflection upon the strength of one's memory, since it is to be kept in mind that data of any kind, to be of scientific value, must be wholly free from doubt. Therefore, while in the field, while the plant is yet in its natural environment, make a careful note of

such facts as cannot be represented in the dried specimen, and place against each plant-description thus made, a reference number.

A little experience in the field will show one that different plants have very different habits, both as to mode of growth and environment. So well defined is this that the experienced collector may, from an inspection of dried specimens or from a general knowledge of the habits of plants, determine in what sort of situations they are most likely to be found. He is therefore able to direct his search for particular species with the least loss of time and labor. Again, the same species, in its wanderings, will sometimes be found in very diverse situations, and probably exhibit corresponding variations. Therefore soil, moisture, exposure, associated species, are all of more or less value, and are to be looked upon as important factors in distribution of the species. No detail of environment is too

trivial to be noted, as one can never tell when apparently unimportant facts may become of the greatest significance, or the extent of the value which may ultimately attach to them. I would therefore say to all those who are commencing the study, as well as to those who are working more or less at random, decide upon a thorough and systematic course of procedure, and follow it out persistently and conscientiously to the end keeping in mind that the discipline thus gained will not only prepare you for success as a botanist, if you eventually take up that study as a profession, but that it will also be of the greatest service in whatever field of labor you may finally decide to cast your lot. It becomes then a question, not so much of the particular knowledge you may have gained, but the habits of thought, of methodical, intelligent, persevering effort you have acquired.

CHAPTER II.
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II.

IMPLEMENTS.

The implements required by the collector are few and simple, and, within certain limits, may be selected according to individual taste and judgement, as determined by circumstances.

Knife.—For the purpose of cutting branches and other hard, woody specimens, and in some cases for trimming up softer plants, a good stout pocket knife is essential. Any good knife with one large and one small blade, of a size adapted to the hand of the collector, may be chosen, but it should be kept in mind that the best steel is always the cheapest, though it may cost a

trifle more at the outset. The vexation of a blade which will cut only one or two specimens before it requires to be sharpened, is an experience the collector cannot afford to repeat at frequent intervals. Individual taste, however, will here find ample scope for its exercise in the style of implement to be selected.

Trowel.—The great majority of specimens require to be extracted from the earth in such a manner as to preserve, intact, all parts below the surface of the soil. Plants growing in loose, sandy soil may be easily pulled up without injury, but not so with all. In many cases the essential part, like tubers or bulbs or tuberous roots, are buried to a depth of many inches, frequently among the roots of trees and shrubs or under stones. To attempt their removal without a proper digging instrument, is to gain a plant which has lost a large part of its value for purposes of study and comparison. A common garden trowel may be employed, but the

cumbrous character of such an implement, as well as its awkwardness in certain situations, places it beyond the consideration of most collectors. The most suitable implement for the purpose is one of the following :—

(a.) A narrow trowel as in figure 1, having a stout, narrow blade $1\frac{3}{8}$ inches wide and $6\frac{1}{2}$ inches long, provided with a stout handle. Such instruments can be obtained for about 75 cents each.



Figure 1.



Figure 2.

(b.) A trowel knife as in figure 2, usually known as the fern knife. This implement has a blade of uniform width, $1\frac{1}{2}$ inches wide and 7 inches long, terminated below in a rounded end and above by a flat handle of the same width. The blade, in cross section, is slightly curved and so ground as to give

a cutting edge on the two sides and end. This implement is the best for the purpose and may be obtained at the same cost as the preceding.

Whichever is chosen, it will be found best to carry it in a leather sheath hung on a leather belt not less than $1\frac{1}{2}$ —2 inches wide, which will also serve as a base to which other implements may be secured.

If lichens are to be collected, there will also be needed a cold chisel and a geologist's hammer for the removal of such as grow upon rocks from which they cannot be separated.

For fresh water algæ a dipping net with a close mesh is essential, and a wide mouthed bottle of about eight ounces capacity, fastened to the end of a stick, will be found most useful.

Many sea weeds may be secured by the dipping net. Others have to be searched for in a boat and secured either with a dipping net or dredging hooks which are con-

veniently made by securing four very large fish hooks to a lead sinker of about four pounds weight. In many cases also, it will be found necessary to have a pair of wading boots, which will protect the person as far as the waist.

Collecting Box.—For the transport and preservation in transit, of the specimens collected, a suitable box is required. This should be as light as is consistent with proper capacity, while its dimensions must be such as will adapt it to the length of average specimens and the reception of as many plants as are likely to be collected during an average day's outing.

The box used by the author for twenty years, and now employed by the students of McGill University, and here introduced as perhaps the best in all respects, has the following dimensions:—

End elliptical, major axis 8 inches, minor axis 6 inches: total length 21 inches, divided into two compartments.

Large compartment, length 18 inches,
cover, $16\frac{1}{2}$ inches long, 7 inches wide.

Small compartment, length 3 inches,
cover, $2\frac{3}{4} \times 5\frac{1}{2}$ inches.

Each end of the box on the **upper** side (see fig. 3) is provided with a strong ring loosely inserted, into which may be caught the snap of an ordinary extension shoulder strap. The covers fasten on the upper side by a lip and tongue. Any good tinsmith can make such a box from the figure and description given, and if made in quantity, should not cost more than two dollars.



Figure 3.

The box may be constructed with only one compartment if so desired, but the

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smaller will be found of particular advantage in the collection of delicate plants or of rock lichens, those which would be injured by or injure the specimens in the larger compartment. The increase of weight is trifling, while the advantages are many.

The cover should extend nearly the entire length of the principal compartment, and open to nearly the full width of the box, in order that plants may be laid in full length without unnecessary bending or breaking. Of course many specimens will be unavoidably longer than the box. These should be carefully broken at such points as will adapt them to the mounting sheet, and then placed in the box. As the box reaches what appears to be its full capacity, additional plants laid on top and pressed down steadily by the cover, will readily find a place within and without damage; and each time the cover is lifted it will be found that there is always room for one more specimen. A box of the form and size given, will hold as many

average specimens as one is likely to secure in an entire day's outing. When going on long tramps and in favorable localities, as also in making collections for class purposes, the author has found a box of double the capacity of the one given, none too large.

The outer surface of the box should never be covered with a dark paint or varnish. By so doing one takes the best means of securing the absorption of the heat rays, and thus one of the principal objects for which the box is constructed, is neutralized with consequent injury to the specimens. If paint at all is desired, white should be employed. The heat rays will thereby be reflected most completely, and the contents of the box kept cool and preserved from injury. But it is far better to leave the tin in its natural condition. False pride and sentiment have no place in the mind of a student of science, and the sooner such ideas are eliminated the better. If it is now explained upon what principle the box preserves

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the specimens in a fresh state, the reasons for the above statements may appear more obvious.

The aggregation of many plants in a relatively tight box, secures the best conditions for the retention of such moisture as they contain. But more than this, when plants are placed in darkness, as in a close box, the function of transpiration is largely arrested, hence, specimens collected under suitable conditions will retain their freshness in the box for many days. Plants like the sow thistle (*Sonchus*), live-forever (*Portulacca*), stone-crop (*Sedum*) and others of similarly succulent character and persistent vitality, will not only keep fresh, but will blossom and go to seed in the box. On more than one occasion I have had such plants come out of the box perfectly fresh, at the end of two weeks.

On the tramp, the box should be so hung by adjustment of the shoulder strap, which passes over the left shoulder, that it will

hang diagonally across the small of the back. In this position the arms and hands are perfectly free for all that may be required of them, while a ditch may be jumped or a fence vaulted without the least inconvenience. When a specimen is gathered, the box is swung to the front, the cover opened, the plant placed within, cover closed and the box swung back into its position, all with the least effort and delay. From these statements it will become obvious why the covers must open on the **upper** side of the box.

For the analysis of flowers, some form of magnifying-glass is necessary. If this work were to be done wholly in the house, the best possible instrument for the purpose would be a regular dissecting microscope which can be obtained at prices ranging from five to twelve dollars or more. Where much work is to be done, particularly in studying grasses, ferns, mosses, etc., such a microscope is essential. In any case a pocket lens of

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moderate magnifying power will be needed. And here there is much opportunity for personal choice. The requirements to be met are convenience of size, ease in using, and a magnifying power of ten to fourteen diameters. Among the many glasses kept by all opticians and most book dealers, it will always be easy to select an instrument adapted to one's taste and purse.

In our own experience we have found nothing better than the glass known as the linen tester, so called from its application to the determination of threads in fabrics.

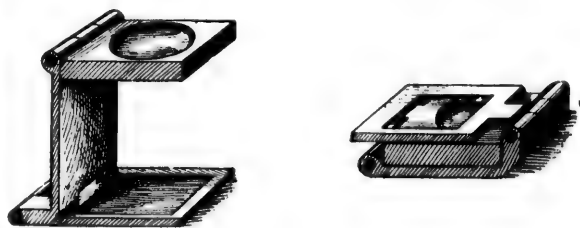


Figure 4.

Figure 4 shows one of these glasses open as in use, and closed as carried in the pocket. The instrument is obtainable in three sizes, ranging in price from fifty cents

to one dollar and one-half. The small size will be found sufficient for most purposes. In this, the focal length of the lens is three-fourths of an inch, with a magnifying power of ten diameters, which is quite ample for most purposes. The aperture in the lower leaf should be fully one-half inch in diameter and square. Special advantages of this lens over the ordinary forms, are to be found in its compactness and in the fact that, when in use, both hands are quite free for such work in dissection, as may be required of them. Dissecting needles are readily made by driving a stout needle into a pen handle, the metal holder of which has been filed off so as to form a ferule.

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CHAPTER III. METHODS OF COLLECTING.

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III.

METHODS OF COLLECTING.

There is no particular time for the gathering of plants, provided they embrace all the elements of complete specimens, except that they should not be collected when wilted by a hot mid-day sun, nor when they are loaded with heavy dew.

One guiding principle should serve as the basis of all collections. A plant to be of future value for purposes of study, must be complete, *i.e.*, it must embrace root, stem, leaves, flowers and fruit. Under certain circumstances it is not possible to realize the ideal specimen. Of trees and shrubs, only a small branch with characteristic leaves,

flowers and fruit can be taken. The rest must be supplied by the note-book. Most herbaceous plants can be taken entire and ultimately mounted without any mutilation of parts. Others, again, as the tall grasses, may be adapted to the herbarium sheet by bending them back and forth, once or twice, at such points as may be necessary. Of very tall herbaceous plants like **Lactuca**, **Mulgedium**, some species of **Solidago**, **Aster**, etc., portions only can be taken, but here care must be employed. In many such cases the root leaves and the stem leaves are totally different, and the specific distinction may rest wholly or in part upon just this difference. Hence it is important to note such variations and see that they are represented in the specimen.

Many plants perfect their fruit long after the flowers have past, others produce their flowers before and fruit with the leaves, while others produce flowers and fruit simultaneously. Care must be taken, there-

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fore, whenever practicable, to collect these various parts, each in proper season.

The student must keep prominently in mind the important fact that plants are gathered and a herbarium is formed, not for the purpose of bringing together objects of beauty which may be employed to interest a few friends on the occasion of social gatherings, but for the express purposes of immediate and future study and reference. Just in proportion as the specimens are perfectly or imperfectly collected and prepared, will the value of the herbarium be measured. Every specimen should be of such a nature that fifty or one hundred, or any number of years hence, a total stranger could take it and correctly determine its character.

It used to be the common practice to encourage school children to collect simply a flower, with possibly a leaf, under the impression that such was a botanical specimen; and it is to be regretted that such

practice finds altogether too much encouragement at the present day, due chiefly, perhaps wholly, to ignorance on the part of the teacher of what is requisite in a specimen. Such specimens are rarely analysed, but are mounted on small sheets of paper, the names are obtained from some one who knows them, because it is too troublesome and difficult to find out for oneself, and the classification is allowed to take its chances. It is unnecessary to point out that such specimens do not in any way meet the object for which they were collected, that they have no scientific value, and that the time, labor and material expended upon them are an almost total loss. It is quite as easy to collect a proper as an improper specimen. In the first case, every moment spent is profitably employed, the collector receives constant encouragement from the consciousness of work well done, while the orderly habits thus engendered are of the greatest benefit as a discipline of the mind.

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In the second case, the time spent is wasted, the collector soon experiences discouragement at witnessing obvious failures, and the effect upon the mind quickly becomes evident in increased shiftlessness and want of purpose.

These remarks are not made with a view to discouragement; on the contrary, the ambitious student should take them as so many steps to better deeds, and once the young collector is fairly launched in his work, he will discover that there is no more fascinating employment for both body and mind, giving to each ample scope for the most active, while each success makes the study more attractive than before.

It happens, however, that the most complete specimen may be wanting in some of the details essential to its final description. The flowers may fade in drying, white may change to black, the height is not represented by the partial specimen secured, peculiarities of environment are never repre-

sented. All these details should be carefully entered in the note-book for future reference, and here it should be again pointed out that memory can never be wholly relied upon for details upon which the accuracy of future descriptions may in any way depend. Memory plays curious freaks, and he would have a most extraordinary mind who could, from day to day, collect a multitude of similar details and, later, apply them accurately to their appropriate objects. Facts gathered for scientific purposes must be so recorded that all question of doubt is eliminated, for where such doubt arises the fact becomes worthless. The importance of these precautions will become evident in the light of experience, even if they are not accepted at first.

With the local collector, plants are described or analysed when fresh; but with the professional morphologist who is engaged in describing thousands of plants from all parts of the world, places which in all probability

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he has never visited, such a mode of procedure is manifestly impossible. Under such circumstances he takes the dried specimen, and, by means of hot water, so softens the various parts as to render analysis and description not only possible, but quite simple. In these circumstances, the notes made by the collector in the field are of the first importance. It is in this way that such works as the Botany of California by Watson, the Flora of New Zealand by Hooker, and all other similar works have been and are prepared.

Having collected the specimens as described, no special care is needed in their transport under ordinary circumstances, since the box provides amply for all conditions usually encountered. When tramping on a very hot day, however, the effect of the heat may be felt in the interior of the box, when the contents may wilt. A small quantity of water sprinkled upon the plants from time to time, will avoid all difficulty.

When the collector reaches the place where his plants are to be pressed, his first care is to determine his species. With practice, this becomes continually easier, until, before long, reference to the genus, or at least to the family, is made at sight. The principle should be adopted that all plants are to be named when they go into the press, or as soon after as possible, for which latter purpose duplicates should be reserved. If this plan is adopted, it will save a large amount of trouble and vexation. When specimens are regularly hurried into the press without analysis, one very soon finds that the rapid accumulation of material puts him so much in arrears with his work, that he either gets a kind friend to supply the names or leaves the work of determination for a more convenient opportunity which rarely or never comes. More or less discouragement is the inevitable result, and all the blame is laid upon the study as being a difficult one and the "names so hard to learn."

One of the primary objects of collecting plants is to study and classify them, and this can only be gained by careful and persistent analysis, which, in the repetition, becomes continually easier. Therefore, if this part of the work is neglected, one fails to receive the very advantages he seeks when he enters upon the study. There are no short cuts, and only persistent effort will overcome the difficulties presented.

Having determined the species, each specimen should be provided with a label which accompanies it through all the various stages, until it is finally mounted on the herbarium sheet. The label may be any ordinary slip of white paper cut twice in the middle to form a short loop, by means of which it can be slipped over a leaf or other prominent part of the plant. It should bear a number which refers to the note-book where all details are to be found, or it may have written upon it the name, date and place of collection and name of collector, as well as

such other details as are not in the notebook, but which require to appear on the final label. Nothing must be left to chance. From first to last be careful to adopt and pursue a methodical course, and the result cannot fail to be satisfactory.

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CHAPTER IV

THE USE OF NAMES.

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IV.

THE USE OF NAMES.

Perhaps it would be pertinent at this point to make a few observations relative to the supposed difficulties of botanical studies. As the young student opens his or her book for the first time, he (or she) is confronted with many long and apparently difficult words, words of strange sound and strange meaning. Each plant is found to have two such words as its name, and each organ or part has its separate name. The thought that all this must be mastered before one can know botany, is too often allowed to serve as a means of absolute discouragement. The pupil comes to look upon the whole subject as one of the greatest difficulty.

No more erroneous conception could be entertained or encouraged, for we can safely say that, if properly studied, there is probably no subject of natural science more inviting than botany. It must be kept in mind, nevertheless, that the pupil must bring to the work habits of studiousness, combined with a desire to know. There should also be a love for plants. No one can make a success of any walk in life unless his (or her) whole soul is in the work undertaken. In other words, you and your chosen occupation should be so closely identified that the two become merged in one.

The names applied to the various parts of a plant are such as in themselves describe those parts most concisely. No other terms would be equally applicable. The two names applied to the whole plant are of Greek or Latin origin, and in every case are, or should be, descriptive of some peculiar feature of structure or place of origin, or commemorative of some distinguished botanist or locality.

Each plant, in accordance with the binomial system of Linnaeus, has two names. The first, or generic name, shows to what group of a family the plant belongs. The second, or specific name, points out the particular type of that genus, and it often happens that these names at once indicate the character or characters by which a plant is to be distinguished from its relatives. Thus *Richardia africana*, the name of the cultivated calla-lily, so-called, shows in the generic name that the plant was named in honor of the French botanist Richard, while the specific name points out Africa as its original home. Again, in *Anemone acutiloba* we have first, reference to the fact that our plant belongs to the wind flowers, and second, that the leaves are **lobed** and **pointed**, characters which are distinctive. These illustrations could easily be multiplied until they filled a book, but those given will suffice for the present purpose.

Now, in designating a plant it is just

as easy to say **Richardia** as **Calla**, with the additional advantage that the first is correct, while the second is wholly incorrect, because the *Richardia* is not a *calla* scientifically speaking, and therefore it is not such at all, except as the name is erroneously given by a misguided popular idea. Much is said at the present time in favor of popular names, and to the detriment of scientific names as being incomprehensible. Why, then, do we commonly say **geranium**, **oxalis**, **anemone**, **camellia**, **lycopodium**, **clematis**, etc., etc. ?—for these are each and all purely scientific names which have been adopted as the common names, because the best. It will probably occur to the reflecting mind that, after all, it is a matter of habit, and that it is just as easy to learn and use the name sanctioned by science as any other. Common names have the very obvious disadvantage that there is no certainty in their application. A given plant often has several common names, each of

which may in turn be applied to several other plants. Each locality has its own peculiar nomenclature, and beyond its narrow limits the names there in use may be devoid of significance.

The student may well ask "But should I not, at the beginning, learn all these difficult names, commit them to memory, and thus have them at call, ready to apply when wanted?" The answer would be most emphatically, no. As you study your plants you will constantly discover the need of special terms. These you will find in a glossary which almost always accompanies your text-book or manual. As the need arises, study out the meaning and application of the term used. You will thus commit it to memory with the least difficulty, and in a manner which will make its retention permanent. To attempt committing a long list of technical terms without direct application is to engender confusion of ideas. When your plant is fully studied, and the need for

a name arises, you will then be able, in the same way, to understand its application.

The end of botanical studies by no means lies in the number of long words one can remember. Technical terms are only a means to an end. They are so many stepping-stones to that which is beyond. If the student will approach the subject from this point of view, the suppositious difficulties will disappear, and in their place will be found that which will not only be a continually augmenting pleasure, but, when other occupations fail, will prove an unending resource of healthy, mental enjoyment.

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V.

PRESSING.

With the plants collected and properly named, it is essential to their permanent preservation that the contained water should be eliminated. This may be done in various ways, but all methods are based upon the principle that the more rapidly the water can be extracted, the better will the specimen retain its natural color and appearance. It is not our purpose at this time to deal with the various means of preserving plants for ornamental purposes, as that is quite foreign to the object in view. What concerns us now is to determine how best to dry plants for the purpose of scientific study. With this object in view, two considerations

must be kept in mind, viz., the perfect preservation of the plant in all its parts and characteristics, and economy of time and labor. A little experience will not only disclose more or less conflict between them, but will enable the collector to determine which must be given the greater preference.

The Press.—The most simple and economical (?), and, on the whole, a very good press, is made of two boards, 12x20 inches, cleated at each end. Between these the plants are piled up in their drying papers, and weights, composed of iron or flat stones, are applied to the upper board. Disadvantages are to be found in the readiness with which such a press topples over when full, unless braced up.

Probably the most serviceable press is one of the form represented in figure 5. It is composed of two boards, one inch thick and 11x24 inches. At each end is a cleat, two and one-half inches wide, well screwed on. Through each end of the lower board, at the

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centre of the cleat, with the latter downward, is passed a wooden screw about eighteen inches in length. The head of the screw fits tightly into the cleat, but butts against a shoulder formed by the somewhat smaller hole in the board. The upper board now drops loosely over the upright screws, upon which are hexagonal wooden nuts, by means of which the requisite pressure is applied. A press of this description is cheap and efficient, and will last a lifetime.

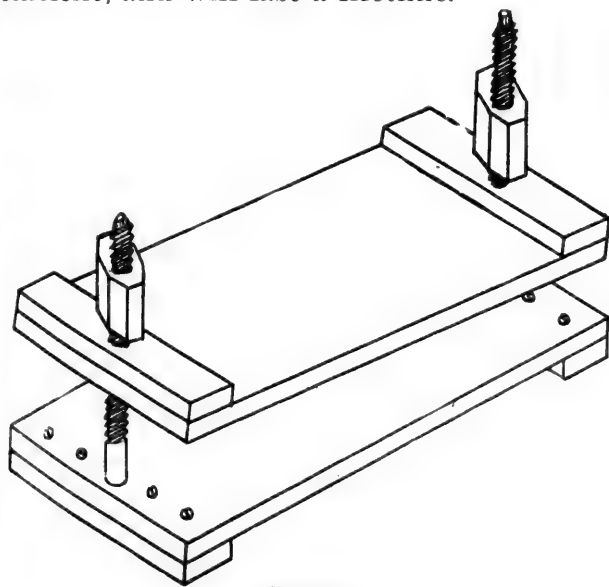


Figure 5.

When going on an expedition of several days, under conditions which would render access to, or the transport of, the press described impracticable, a portable press should be employed. This, in its best form, is composed of two sides or "boards," made of coarse wire netting stretched upon a strong iron frame. The pressure is applied by means of strong straps, which also furnish the means of convenient transport. The special advantages of this form, over other portable presses, are its lightness, strength, and the fact that, through its open structure, the papers and plants will dry rapidly while in transit.

Drying Paper.—An ample supply of soft, bibulous paper should be provided. As this is employed with a special view to the extraction of moisture from the plants, its suitability for this purpose should be carefully ascertained. The paper generally employed is usually made of woollen rags, and is in all respects similar to carpet felt-

ing, except that it is much softer, being wholly free from filling substance. It must be capable of taking up moisture rapidly. The sheets should be 12x18 inches, and if one is intending to do much collecting, at least three or four hundred sheets will be required. A sample of this paper will be found at the end of the volume.

One should also provide an ample supply of old newspapers cut to the same dimensions in single sheets, and experience will show that several thin boards, or better, sheets of mill board about $\frac{3}{16}$ inch thick, will be of great service.

Everything is now ready to put the plants in press. To do this, raise the upper board of the press, and let it hang upon the screws as shown in the figure, by simply dropping one end after raising the whole to the required height. Now place upon the table in front of you, a few sheets of drying paper, and upon this one of the sheets of newspaper. Upon the latter place your specimen, care-

fully arranging the parts in natural position. Do not force a flower open or otherwise distort any of the parts. Having done this, cover the specimen with a sheet of newspaper, and on the whole place from two to several sheets of the drying paper, according to the nature of the specimen. The more succulent the plants, the greater the number of drying sheets should separate them, and the same rule will apply where delicate plants are next to hard, woody specimens by which they would be injured. It frequently happens that a plant will not lie flat while the drying papers are being placed over it. In such cases, with one hand lay on the sheet of newspaper, while the other hand spreads out the parts of the plant and holds them down. The weight of the drying paper will then keep all parts in position. Very great care at this time is not essential, since disordered parts can easily be arranged when the specimens are changed the first time, with the great advantage that, owing to their

wilted condition, all parts may then be made to lie flat and keep the positions assigned them. Having thus placed all the specimens between papers, the entire pile is put into press, the upper board dropped, and pressure applied by means of the screws. If there are many hard, woody specimens, it will be found best to separate them occasionally from one another, and particularly from soft specimens, by means of the thin boards or mill boards already referred to.

The pressure to be applied at this time must not be great. Ordinarily it should not exceed 25-30 pounds. If more is applied while the specimens are full of water and all their tissues are in a state of high tension, they will be crushed, and many of them ruined. It must be kept constantly in mind that pressure is not applied with the object of mechanically forcing the water out of the specimens, but primarily to hold all parts in position and prevent curling, while the water is eliminated by the absorptive paper.

As this drying progresses, more pressure may be applied, until, after the second or third change of papers, when there is no longer danger of crushing, all the pressure you are capable of may be applied, and thus the drying will be hastened. The time required to properly dry plants varies with the nature of the specimen and the local conditions of humidity. In this climate many plants will be dried in two or three days, others will require a week, and a few may need ten days or a fortnight.

Certain specimens may need special treatment before they are put in press. Thus in such plants as **Symplocarpus**, where the parts are thick and fleshy, it is better to allow such to wilt thoroughly before putting them in press. Again, such flowers as the lady's slipper (*Cypripedium*) or the leaves of the pitcher plant (*Sarracenia*) are improved by partly filling the cavity with cotton, which will distend the parts somewhat and tend to preserve the natural form. Woody stems,

thick rhizomes, tubers, bulbs, corms and similar organs should be cut in half, and, in some cases, the interior parts should be carefully removed. A thick spadix like that of **Symplocarpus**, or spikes like those of the cat-o'-nine-tails (*Typha*) or sweet flag (*Acorus*), should be treated in a similar manner. Beyond this, experience which, after all that can be said, is the best teacher, will soon discover to the intelligent student the proper course to pursue.

Adopting the principle already laid down, that the most rapid drying is consistent with the best preserved specimens, it will not be difficult to recognize that a frequent change of papers is essential. At least once each day all the plants should be taken out of the press and placed between dry papers, the moist ones being placed near a stove or spread out in the sun to dry. At this point the utility of the newspapers becomes apparent. Were the plants placed directly upon the drying paper, they would adhere to

it, and considerable force would be required for their removal, with consequent injury and possible loss of rare specimens. With the plant between thin newspaper, the whole is transferred as the specimens are changed from day to day, and no disturbance of the contents is made until the plant is wholly dry, when it separates from the paper spontaneously.

Change of specimens to dry papers should be made at least once each day, and more frequently if possible. Under such circumstances, in this climate, where the conditions favor rapid desiccation, it will be found quite easy to preserve the normal color of most flowers and leaves. In more humid climates, however, the difficulty of accomplishing this is often very great, and during the rainy season, in the tropics, plants frequently decay in the press. They always come out more or less discolored, and sometimes almost black. In this latitude there should be no difficulty whatever, and specimens

which are discolored may, with few exceptions, be taken as evidence of carelessness.

Test of complete dryness may be made by the touch, but one must learn to distinguish between the sensation of dampness and the sensation of coldness. If the fingers do not prove sufficiently sensitive, application to the cheek will enable a decision to be reached.

As fast as the plants are dried, they are laid away in a pile between old newspapers until they can be mounted.

CHAPTER VI.
MOUNTING.

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VI.

MOUNTING.

Paper.—For permanent preservation, and to facilitate reference, all plants require to be mounted on sheets of paper of uniform size, color and quality. It should be **white** in order to give the sharpest contrast. Colored paper should never be used. The surface should be smooth and hard, but without gloss. The weight must be such that a sheet may be handled without danger of its bending too readily, while the extreme of cardboard must also be carefully avoided. These requirements are met in the sample given at the end of the book. If ordering

of any dealer in such paper, the number and size will be sufficient, or it may be designated more exactly as Silverburn Linen, 18x23, 36 lbs., to be cut in sheets $11\frac{1}{2} \times 17$.

These directions will secure paper of standard quality and size, from whatever source it may be ordered.

The sheets should be $11\frac{1}{2} \times 17$ inches. This conforms to the general standard of most herbaria, is an economical size to purchase, and is adapted to the dimensions of average specimens. It is also the standard used by the Geological Survey of Canada and by McGill University, and is therefore recommended to secure uniformity with the herbaria of these institutions.

Various methods are recommended whereby the specimen is attached to the sheet. One of these is to sew the plant on with strong white thread. Such a method has no advantages, while it has many obvious disadvantages. Some of the more prominent of these are, that the specimen is always

loose, and if used at all, will very soon separate from the sheet altogether.

A second method is to use narrow strips of thin and tough gummed paper, which are secured over all the prominent parts of the plant. The latter is thus held down firmly at first, but with use soon works loose and parts break off, while the strips are always more or less unsightly. Then too, the time and labor needed in this process are very great, and this has, in more than one case, acted as a deterrent, preventing collectors from entering into the work with much enthusiasm.

The supposed advantages of these methods are, that the parts required for examination are readily inspected and easily removed. This argument is of no value whatever. If a specimen is properly prepared in the first instance, it is at all times suited to examination of its various parts, if mounted according to the method about to be described.

The method now adopted in all large

herbaria, is to glue the plant directly to the sheet. This has all the advantages of durability, utility, economy and beauty of finish to recommend it. For this purpose a brittle glue, like gum arabic, should never be used, but rather a strong, tough glue such as is found in fish glue, usually sold as Le Page's Liquid Glue. This is the cheapest and best article for the purpose that is made. In the McGill College Herbarium we use the grade known as carriage glue, which is much too thick for direct use, but by dilution with one-half volume of water, it is reduced to proper strength for average plants, while dilution with an equal volume of water adapts it to pasting labels. Too much should not be diluted at one time, as there is a tendency when in this condition, for decomposition to set in after one or two days. Provide a rather soft round brush, about $\frac{3}{4}$ of an inch in diameter, such as painters use. To apply the glue, place an old newspaper on the table in the front of you, with

the pile of specimens to the right and the pile of mounting paper to the left. Take up your specimen and examine it carefully, to see which is to be the outer or uppermost side. Having settled this, reverse the specimen on the newspaper, and with the brush apply a small quantity of glue to each leaf, flower, various parts of the stem and wherever it appears to be needed. A large amount of glue is not only useless but disadvantageous. Only enough should be applied here and there to insure close union of specimen and paper. Now lift the plant carefully and reverse it upon the mounting sheet, taking care to drop it directly into its proper position. Remove the sheet to the left and cover with a sheet of the drying paper, to take up any surplus glue and prevent the specimens sticking together. Continue to pile the specimens in this way, occasionally introducing a thin board. When the pile has reached convenient height, place a couple of bricks on top and

set to one side until the glue has hardened.

Objections have been raised that this method results in unsightly glue on the specimen, or of more unsightly blotches of fuzzy paper like some great excrescence. Having mounted about twelve thousand specimens in this way, during the last six years, I feel justified in saying that when such blemishes occur, they are the result of carelessness. If the precaution is taken to limit the amount of glue used, and never to paste on the same sheet of paper twice, difficulties of this kind will wholly disappear or be reduced to accidental occurrence.

With very delicate plants and grasses, it will probably be found best to spread a fairly thick layer of glue over a limited area of the pasting sheet, the specimen is then taken up with forceps and carefully laid in the glue so as to gum a number of parts. Or, apply the glue in the usual way and then, without lifting it from the pasting sheet, lay the sheet of mounting paper upon it, pass

the hand lightly over the surface and lift it. The specimen will now be found adhering to the sheet without any unsightly glue.

Mosses may be glued on in the usual way, placing four specimens of the same species, but from different localities, on the same sheet. If too small to treat in this way, make a paper pocket like the sample at the end of the book, and place the specimen in it without using glue.

Lichens may be mounted the same as mosses when their dimensions will admit. As most of these plants are stiff and brittle when collected, and more or less bulky, they should be placed in water until pliable, then placed in the press until dry.

Sea weeds require somewhat different treatment. Large plants like the Fuci, which have relatively little mucilage, should be dried under pressure in the usual way and mounted with glue. Laminarias may also be treated in the same manner, but as they contain rather more mucilage, they

may be pressed directly upon the herbarium sheet to which they will then adhere firmly. The delicate seaweeds need to be floated out in a large basin of salt water. Quarter sheets of the herbarium paper are now slipped underneath and carefully raised out of the water with the specimens upon them. If necessary, the parts are then arranged with needles and the whole is allowed to dry, usually without pressure. These small sheets are then secured to sheets of the standard size.

It is not uncommon to find mosses, lichens and many sea-weeds mounted on very small sheets. This practice we consider objectionable because :—

1st. It destroys the uniformity of the collection as a whole.

2nd. In collections of seaweeds it necessitates the use of two sizes of paper or an undesirable limitation of the specimen.

3rd. It is not consistent with economy of time and labor.

4th. It demands cases of totally different dimensions or else involves waste space in those of the ordinary size.

5th. The packages are of most awkward dimensions.

6th. There are no compensating advantages.

It is therefore much better to adopt a uniform size of sheet for all specimens, and adapt these to it as directed above.

CHAPTER VII.
LABELS AND ARRANGEMENT.

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VII.

LABELS AND ARRANGEMENT.

Plants properly mounted must bear a label giving necessary data. Such facts may be written upon the lower right-hand corner of the sheet, but this is a practice which does not commend itself to orderly minds. The general practice is to have a special, printed form of label of uniform size and style. Experience always shows that the more simple the label with respect to printed headings the better, and for small collections this will always be a safe rule for the beginner to follow. Where large collections of the flora of a particular district are to be made, and particularly when many exchanges

of such plants are to be sent out, the whole label may be printed, as shown in the specimens Nos. 1 and 3. For mosses, it may be found desirable to use a label of smaller dimensions, but otherwise similar to the others, as in No. 2.

Reference to the specimens in the appendix, which are samples of labels actually in use, will enable one to select such as are adapted to particular needs. In ordering from dealers, the number of the label and the heading desired are all the directions required.

In all cases the paper for the labels should be white and of light weight, and the type clear and plain. If too thin, the paper will curl badly in pasting, and if too heavy, it will not adhere quickly to the sheet. The surface must be hard and well adapted to writing with a pen. In writing the details, none of the ordinary iron inks should be used, as they fade out in time, but employ a good carbon ink, such as India ink or Higgins'

waterproof drawing ink. This will be permanent. The details on the label must show the generic and specific names of the plant, together with an abbreviated form of the name of the author by whom the plant name was given, the date of collection, locality and name of collector, with such additional information as may be necessary. When completed, it will have the appearance of figure 6.

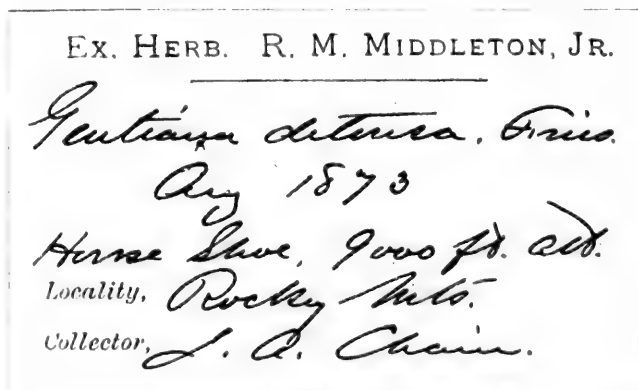


Figure 6.

Where large numbers of plants from the same locality are collected, and particularly where such are to be exchanged in quantity,

it is most economical to have the entire label printed. It then assumes the appearance of figure 7.

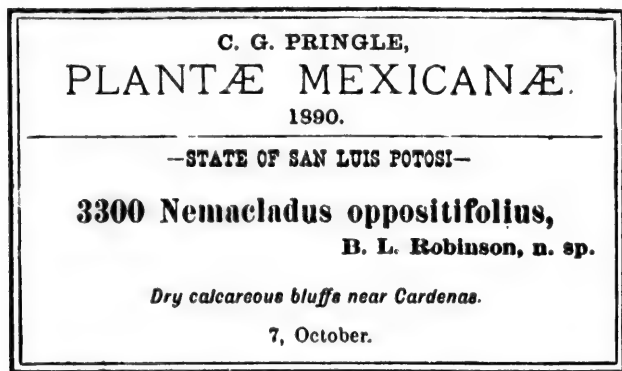


Figure 7.

When more than one specimen is mounted on the same sheet, each should have its proper label directly beneath. When only one specimen is on a sheet, the label should always be placed in the lower right-hand corner, for reasons which will appear later.

The plants may now be regarded as finished, but require to be arranged with reference to relationship. For this purpose we provide folded covers of stout Manilla paper like the sample given, into each of

which, for collections not exceeding one thousand specimens, a family is placed. The cover is then provided at the lower left-hand **folded** corner, with a simple label bearing the name of the family and genus. For larger collections, each genus should have a separate cover, and in herbaria of several thousand specimens, several such covers will often be needed for one genus. In this case, the genus label may be printed and bear data arranged as shown in figure 8.

Exostemma, Rich.

ORDER 84.

39.

Figure 8.

The numbers here correspond to the number of the family and genus as in Bentham and Hooker's *Genera Plantarum*, which thus becomes an index to the herbarium, and the

work of arrangement or the insertion of new specimens is greatly facilitated.

It now remains only to arrange the specimens in their proper order. This must be done in accordance with the arrangement given in any one of the various manuals, such as Gray's Manual of the Northern United States, or in Macoun's Catalogue of Canadian Plants. This arrangement is that which is supposed to represent the natural sequence in development, so that the most highly developed family would come first, the genera and species following in the same order. If, therefore, care is taken to preserve such an arrangement when once made, it always serves to point out the position and affinities of the various groups and species. The preservation of this order depends upon the care exercised in handling the plants, a matter which is simple in itself, but too often disregarded.

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CHAPTER VIII.

CASES AND PRESERVATION.

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VIII.

CASES AND PRESERVATION.

The permanent preservation of specimens necessitates a case of some kind, in which they may be protected from dust, insects and mechanical injury. Forms of various kinds will be suggested, and an abundant opportunity is offered for personal choice. Tin cases, opening at the end by a door with double joints, and capable of holding from 200 to 400 specimens, are often employed. They serve as a special protection against dampness and insects(?) Ordinarily, a case of half-inch wood, of a size adapted to requirements, is all that is needed. For a small collection such a case might measure

12½x18x12 inches inside. One end opens as a door, and the interior space is divided transversely by a sliding shelf into two equal parts. In a case of any dimension, the shelves should not be more than six inches apart from centre to centre, otherwise the weight of material will injure the lower plants on which it rests.

It unfortunately happens that dried plants are subject to the ravages of a minute insect known as the herbarium mite. Various precautions are taken to guard against its operations. One of the most common devices is to employ a solution of corrosive sublimate in alcohol, in the proportions of 1:20. This is applied by filling a large meat platter, into which the plant is then laid. The latter is next raised with forceps, and allowed to drip a few moments, then laid between sheets of press paper under light pressure until dry.

The use of corrosive sublimate is open to serious objection. Special danger is likely to

be found in the dust constantly arising from the plants, when large numbers are constantly under examination. The fine particles of the mercuric salt are thus inhaled, and are very likely to produce bad effects. Even with such a poison upon them, plants will, sooner or later, suffer from the attacks of the mite, and only by going through the collection from time to time can immunity be secured.

Cases lined with red cedar have also been recommended, and lumps of camphor have been placed on each shelf with varying degrees of success. Or yet another method of treatment is to use no poison until insects make their appearance. The plants are then placed in a tight box with bisulphide of carbon or chloroform, and allowed to remain until it is certain they have been thoroughly permeated.

In our own experience, the corrosive sublimate has been discarded altogether as affording results not at all commensurate

with the time and labor involved in its use. We prefer to place upon each shelf a piece of albo-carbon (Naphthalene camphor) which serves a most excellent purpose. If then an occasional plant is found, which shows the action of insects, it is at once treated with a volatile insecticide and such operations are at once checked. With these precautions, little danger need be apprehended.

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CHAPTER IX.
THE USE AND TREATMENT
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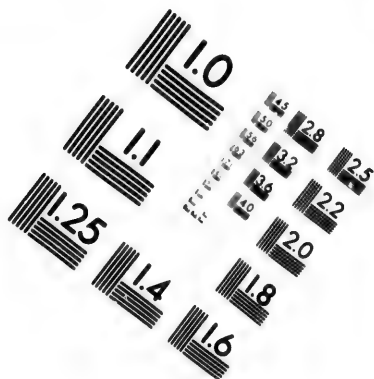
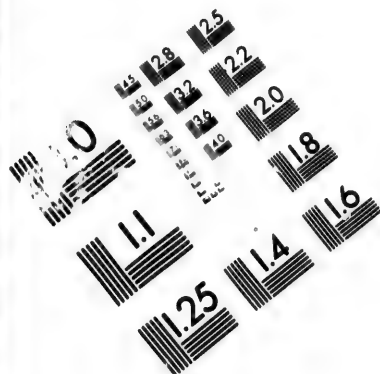
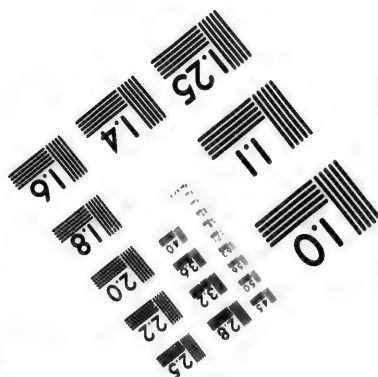
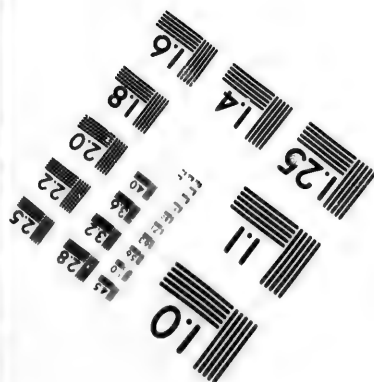
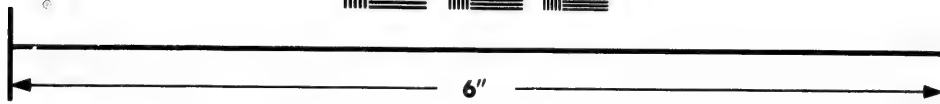
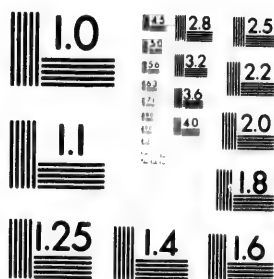


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IX.

THE USE AND TREATMENT OF SPECIMENS.

So far, all our efforts have been directed towards the preparation of specimens which shall be of direct scientific value, and should therefore be available at any time for analysis, or comparison with other plants; and it is desirable to now point out how such specimens should be handled. It is an unfortunate fact that many of those who have access to herbaria do not know how to handle the specimens. The result is confusion, damage or total loss.

Plants as arranged in their respective genus covers, must be looked upon as so many books of which each specimen sheet

is a leaf. They must therefore be treated precisely as if they were all bound into one inseparable whole. When several packets of plants are taken from a shelf, they should be successively turned over until the one sought is found. Then the cover being opened, the sheets are successively turned over to the left until the species wanted is reached. When all is done, return the pile to its proper position and order by simple inversion of those removed. The original arrangement is thus preserved intact. Nothing is more annoying than to have a well arranged herbarium upset by an ignorant person, who will not take the trouble to exercise a little judgment and care, but leaves the whole in a delightful state of chaos which may take many hours to rectify.

In examining a single specimen, the sheet may be caught at the lower end in such a manner that, when lifted, it bends sharply at the middle and the specimen is destroyed. For such carelessness there is no possible

excuse. When taking up a sheet, extend the four fingers of the hand beneath it in such a way as to form a depression at the centre. Into the hollow thus formed, press the thumb as it is brought down upon the paper, which is thus bent slightly throughout its length so as to form a section of a cylinder. The paper thereby acquires a rigidity which will, with ordinary care, be proof against its bending.

From what has been said as to arrangement and selection of specimens, it will be obvious that by having the species label on the lower right hand corner of the sheet, reference to specimens is greatly facilitated. This would be otherwise were the label in the lower left hand corner.

When a plant is to be analyzed, and it is requisite to remove a flower or other part which has been glued down, this is easily accomplished by placing upon the part wanted, a small quantity of hot water. This is allowed to stand a short time, when the

specimen may be removed without damage to adjacent parts. After a little further immersion in hot water, the flower will be so far softened that analysis follows almost as readily as in the fresh specimen.

Finally, in distributing specimens to others, be most careful that they are in all respects what they should be. By no means send a poorly-preserved or a fragmentary specimen, unless the circumstances are of such an exceptional nature as to justify you in so doing. If you have only one specimen of a rare plant, keep it yourself; under no circumstances should you divide it upon the principle of half a loaf. A divided specimen has no particular value for anyone, while the possession of a complete and unique specimen does give exceptional value to the whole collection.

Nothing is more annoying to a good collector than to have poor and imperfect specimens sent to him as an equivalent for good ones. The person who adopts such a

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course is sure to find his list of exchanges rapidly contracting. And again, do not be niggardly in distribution. Unless large, make it a rule to send two plants of a kind, and when very small, as in *Viola blanda*, send at least half-a-dozen or more.

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APPENDIX.



APPENDIX.

In choosing labels for a herbarium, the following styles, reproduced from labels in actual use, may serve as useful guides. The printed details will, of necessity, depend to some extent upon circumstances. Forms No. 1 A, B, C, are adapted to general herbarium purposes.

McGILL COLLEGE HERBARIUM.

No. 1 A.

Locality,

Collector,

HERB. A. F. HOLMES, M.D.

No. 1 B.

Locality,

Collector,

HERBARIUM OF GEOLOGICAL SURVEY DEPARTMENT.

No. _____

No. 1 C.

Habitat _____

Locality _____

Collector and Date _____

No. 2 is the form of label used in the McGill College Herbarium for mosses, lichens and algæ, a somewhat smaller size being used for such plants because of the probability that four labels may appear on one sheet.

Locality

Collector and Date

McGILL COLLEGE HERBARIUM.

No. 2.

Labels for purposes of exchange, and also for plants of a given district, may take one of the following forms :—

EX. HERB. R. M. MIDDLETON, JR.

No. 3 A.

Locality.

Collector.

E.

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Collector.

Ex. Herb. Geol. & Nat. Hist. Survey of Canada

No.

No. 3 B.

Hab.

Loc.

Col.

Date

Ex. Herb. Geological Survey of Canada.

— ◆ —
CANADIAN PLANTS.
— ◆ —

NO. 3 C.

COLLECTED BY

JOHN MACOUN.

1890.

Ex. Herb. Geological Survey of Canada.

— ◆ —
BRITISH COLUMBIA PLANTS.
— ◆ —

No. 3 D.

Revelstoke, May, 1890

JOHN MACOUN.

In all of the above forms the ruled lines do not appear in the label, but are introduced here simply to indicate the actual dimensions, with the exception of No. 1 C and No. 3 B.

SAMPLES OF PAPER.

FOR MOUNTING PAPER.



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FOR COVER PAPER.

SAMPLE OF

POCKET FOR MOSSES AND SEEDS.

To be made of the same paper used for
mounting specimens.

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